IN SEARCH OF A GEOPHYSICAL MODEL FOR LIGHT WINDS AND CALMS

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ABSTRACT

LIGHT WINDS ARE IMPORTANT TO INVESTIGATORS WHO STUDY METEOROLOGY, ATMOSPHERIC AND OCEAN MODELING, ENVIRONMENTAL ENGINEERING AND POLLUTION. AS IS EVIDENT, THE PRESENT GEOPHYSICAL MODEL FUNCTION, WHICH USES ELECTORNIC INPUT FROM CAPILLARY WAVES FROM THE OCEAN SURFACE, DOES NOT DO WELL FOR LIGHT WINDS AND CALMS. LIGHT AND CALM WINDS CAN BE PLACED IN A RANGE OF 0-5 METERS PER SECOND.

DATA FROM THE SEA WINDS RADAR ON QuickSCAT ARE USED TO STUDY THE PROBLEM MORE THOROUGHLY.

THE SEA WINDS RADAR IS CALLED A SCATTEROMETER AND IT BEHAVES LIKE AN ANEMOMETER AT THE OCEAN SURFACE FROM WHICH THE WIND SPEED AND DIRECTION OF 10 METERS ABOVE SEA LEVEL CAN BE INFERRED. THE LOCATIONS AND PROPERTIES OF NEGATIVE BACKSCATTER VALUES IN SUBTROPICAL HIGHS, THE DOLDRUMS AND OTHER OCEANIC AREAS, WITH RESPECT TO LIGHT WINDS AND CALMS ARE AT THE

CENTER OF THIS INVESTIGATION.

INTRODUCTION

THE TERM SCATTEROMETER IS USED TO DESCRIBE A SPECIALIZATION OF MICROWAVE RADAR THAT IS DESIGNED TO MEASURE NEAR SURFACE WIND VELOCITY. A SCATTEROMETER MEASURES THE RECEIVED SIGNAL POWER PLUS THE NOISE AND THE RECEIVER NOISE ALONE. AN ESTIMATION OF THE NET POWER RECEIVED BY THE SCATTEROMETER IS THEN OBTAINED BY SUBTRACTING THE RECEIVER NOISE OR INTERFERANCE FROM THE TOTAL POWER RECEIVED BY THE SCATTEROMETER. VARIOUS THEORIES FROM THE AREAS OF PROBABILITY AND STATISTICS ARE INCORPORATED IN THE DESIGN AND OPERATION OF A SCATTEROMETER. MULTIPLE, COLLATED, RANDOMLY SAMPLED SIGMA0 (s) MEASUREMENTS FROM DIFFERENT DIRECTIONS ARE GROUPED WITHIN AN AREA SAY 25 SQUARE KM WITH AN ASSOCIATED LATITUDE AND LONGITUDE CALLED A WIND VECTOR CELL (WVC). THESE VALUES ARE USED TO SOLVE SIMULTANEOUSLY FOR THE WIND SOLUTION WITHIN THAT CELL VIA THE GEOPHYSICAL MODEL FUNCTION (GMF). THE GMF IS A FUNCTION OF WIND SPEED,

DIRECTION AND INCIDENCE ANGLE. WIND RETRIEVAL IS ACCOMPLISHED BY

"INVERTING" THE GEOPHYSICAL MODEL FUNCTION (GMF) FOR A SET OF SIGMA0 (s)

MEASURMENTS TO OBTAIN MULTIPLE ESTIMATES OF THE WIND SPEED AND DIRECTION

(AMBIGUITIES), AND THEN SELECTING THE FINAL WIND FOR THAT SET. IF THERE ARE

ZERO AMBIGUITIES WITHIN A WVC THEN NO WIND WAS MEASURED FOR THAT

LOCATION

THEORETICALLY THE ESTIMATES FOR SIGMA0(s) ARE

POSITIVE, WHICH MEANS THAT THE THEORY OF BACKSCATTER DOES NOT ALLOW FOR NEGATIVE SIGMA0 VALUES. THERE MAY BE CASES WHERE THE RECEIVED SIGNAL IS SMALLER THAN THE RECEIVER NOISE AND THUS PRODUCES NEGATIVE VALUES FOR SIGMA0. ANOTHER CASE MAY BE WHERE THE BACKSCATTER POWER IS SO SMALL THAT IT IS VIRTUALLY INDISTINGUISHABLE FROM ZERO. TO FURTHER IMPROVE THE CHANCES OF HAVING A CORRECT MEASUREMENT OR ESTIMATE FOR SIGMA0 (s) A MAXIMUM LIKELIHOOD ESTIMATOR (MLE) IS USED. THE LARGER THE VALUE FROM THE MLE THE GREATER THE PROBABILITY THAT YOUR DATA IS CORRECT. DESPITE THESE MEASURES THERE ARE STILL OCCASIONS WHERE DATA FOR LOW WIND

SPEEDS ARE HANDLED INCORRECTLY.
THE LOCATIONS WHERE THE NUMAMBIGS DATA FLAG IS

EQUAL TO ZERO INDICATE REGIONS WHERE THE WIND

DATA WAS DISCARDED. THE FACT THAT A SIMULTANEOUS

SOLUTION FOR THE WINDS WITHIN THESE WVC COULD NOT

BE FOUND TELLS US THAT THE GEOPHYSICAL MODEL

FUNCTION (GMF) HAS PROBLEMS WITH LOW WIND SPEEDS.